Higher Energy Prices, Where Are They Leading Agriculture?[1]

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U.S. agriculture is facing inevitable energy price increases. The United States continues to increase its consumption of energy at current energy price levels. Domestic energy production has leveled off or declined slightly and reliance is increasingly placed on imported oil. It is becoming apparent that increased importation of foreign oil is burdening the country's balance of payments. The result has been a dramatic decline in the value of the dollar on international markets. Thus, reduced supplies of foreign oil seem to be necessary to correct a situation where the value of imports is far exceeding our country's exports. It is likely that these reduced supplies will increase the price of energy to all users including agriculture.

The intent of this discussion is to outline the changes which might be expected in U.S. and Ohio agriculture with energy price increases on the order of 100 percent. Although extraordinarily high by historical standards, these price levels are faced by most consumers outside North America and may be facing us in the not too distant future. First, the impacts of this price rise on U.S. agriculture are discussed, and then possible impacts on Ohio agriculture are considered.

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Two points are basic to understanding the effects of energy price increases on U.S. agriculture. First, the demand for energy in agriculture is very inelastic. That is, as prices of energy are increased, agriculture usage of energy declines very little. Our agriculture has developed over the past century with a heavy reliance on energy. As Carter and Youde point out,

> . . . the capital stock for agriculture and other basic industries was built during a period when current and expected energy prices were low. . . Machines would need to be redesigned. . . long lead times would be required to change agriculture's technological configuration. Furthermore, land ownership and tenancy developed during the past century is not adaptable to labor intensive production. . .

Thus, farmers must rely on an energy intensive technology. Some minor shifts can be made as will be seen later, but increases in energy prices have relative small impact on total energy usage in agriculture.

The second basic point is that farmers use a small portion of the nation's total energy. Farm production consumes only about 3% of U.S. total energy consumption (U.S.D.A.). Energy savings in agriculture would have only a minute effect on total energy use. This fact coupled with agriculture's inelastic demand for energy means that it is likely that agriculture can compete strongly with other industries for scarce energy supplies. Agriculture probably will continue to be a heavy user of energy with much of the reduction in energy use falling on other sectors (e.g., household consumption and transportation).

An Iowa State University study offers evidence to support the contention that agriculture's usage of energy remains high under higher energy prices (Dvoskin and Heady). This analysis indicates that U.S. agricultural energy consumption would be reduced by about 5 percent with a doubling of energy prices. While total agricultural consumption changes little, some major changes would occur within agriculture.

First, there would be a severe reduction in the number of irrigated acres in Western agriculture. Doubling energy prices would decrease irrigated production by 22 percent. The reason is that irrigation is an extremely intensive energy user, and sharply higher energy prices would make some irrigation unprofitable. Of course, Midwestern agriculture would benefit from this reduction in irrigated acreage since it would be producing a higher proportion of the total agricultural production.

The second national impact of note is that cropland would expand with a doubling of energy prices. Land not now in production would be substituted for water and energy resources. Much of the increase would occur in Western dryland crops. While the increase in total cropland is slight, about 2.4 percent, the impact of this marginal cropland on soil erosion and sedimentation could be significant.

The third notable impact of doubled energy prices on U.S. agriculture is the small decline in nitrogen application to crops. Of course, commercial nitrogen production is energy intensive, thus the decline in nitrogen application in not surprising. However, the surprising result of the study is that doubling energy prices would reduce nitrogen application rates by only about 5 percent. While the use of commercial nitrogen is curtailed by about 14 percent, it is partially offset by an increase in nitrogen from legumes. Thus, more legumes would be seen in crop rotations, but the increase is rather small.

Some shift would be expected from conventional tillage to reduced tillage crop production. However, this shift is minor since total energy requirements are nearly the same for both conventional and reduced tillage systems. More evidence of the similarity in energy requirements is presented later.

In summary, a doubling of energy prices would have a small impact on agriculture's consumption of energy because of limited technology options. Rather farmers would have to absorb this cost increase and eventually pass it on to the consumer. The price rise would have a negative impact on Western agriculture as irrigated cropland would be forced out of production. Nationally, cropland acres would increase with a resulting increase in soil erosion and sedimentation. Also, commercial nitrogen usage would decrease while legume production would increase slightly.

Ohio agriculture could expect some changes from doubled energy prices. First, the possible changes in crop acreages are examined; next, the changes in crop production systems are presented; finally, some evidence is presented that farmers may begin to produce energy products under these higher prices.

Currently, there is dichotomy in Ohio crop production. The western half of the state is much like the Corn Belt and specializes in row crops. In the northeastern quadrant, less intensive crop systems occur. In the western half, corn-soybeans or continuous corn have become predominant rotations. Fences have been removed, livestock facilities have been abandoned, woodlots cleared, and pastures have been plowed. Livestock systems have become more intensive with confinement swine, dairy, and beef systems replacing pasture systems. In the western half of Ohio, over 50 percent of the cropland is devoted to corn and soybeans with small grains, hay and pasture totalling less than 30 percent of cropland (Sitterley). In the northeastern portion of the state where dairy production is an important enterprise, nearly 60 percent of the cropland is in small grains, hay, and pasture, and livestock numbers have increased over the past four decades (Sitterley).

Energy price increase are not expected to change these general crop production patterns. Price incentives for Corn Belt farmers to retain intensive crop production practices will remain. Studies at The Ohio State University indicate that energy price increase and resulting nitrogen fertilizer price increases would have little impact on either nitrogen application rates or corn acreage. Each 10 percent increase in the price of commercial fertilizer would reduce nitrogen application rates by only about 1 percent. Furthermore, corn acreage would decline only slightly with an increase in energy prices (Forster and Rask). Similarily, energy price increases would have minimal impact on land use in northeastern Ohio where legumes already are extensively used.

Reduced tillage systems might be thought of as an energy saver since fuel costs are less with reduced tillage than with conventional tillage. However, reduced tillage systems require higher energy inputs for pesticides which largely offset these fuel savings. When the total crop production costs are computed for conventional, minimum, and no tillage systems, only minor energy cost differences are present (Figure 1). When comparing conventional and no tillage systems, direct energy costs differ by $2 per acre and indirect energy costs differ by $1.50 per acre (Rask and Forster). Direct energy costs include fuel, drying, transporation, and nitrogen fertilizer, and indirect energy costs account for the energy embodied in machinery, seed, herbicides, and phosphate and potash fertilizers.

As energy prices increase, the relative profitability of conventional, minimum, and no tillage systems remain nearly constant (Figure 2). The tillage system comparison in Figure 2 is divided into short run and long run situations for three soil types. In the short run, only direct energy costs are expected to increase when energy prices increase. In the long run, both direct and indirect energy costs increase as energy prices increase.

Notice the advantage of no tillage on well drained soils. Even with energy price increases of up to 100 percent, its advantage over conventional and minimum tillage remains unchanged. On poorly drained soils, minimum and no tillage retain about the same advantage over conventional tillage under all energy price levels. Finally, as shown in the botton section of Figure 2, conventional tillage retains the edge on very poorly drained soils regardless of the energy price level.

With a doubling of energy prices, we will undoubtedly see some changes toward more energy efficient crop production technologies. An example is the promising innovation of drying grain with solar energy. Solar collectors are used to provide the supplemental heating that would normally be used in a low temperature drying system. A variety of these collectors are possible, but the idea

Figure 1. Direct Energy, Indirect Energy and Non Energy Costs (Excluding Land Costs) Per Acre of Corn Under Conventional, Minimum, and No Tillage, Brookston Soils

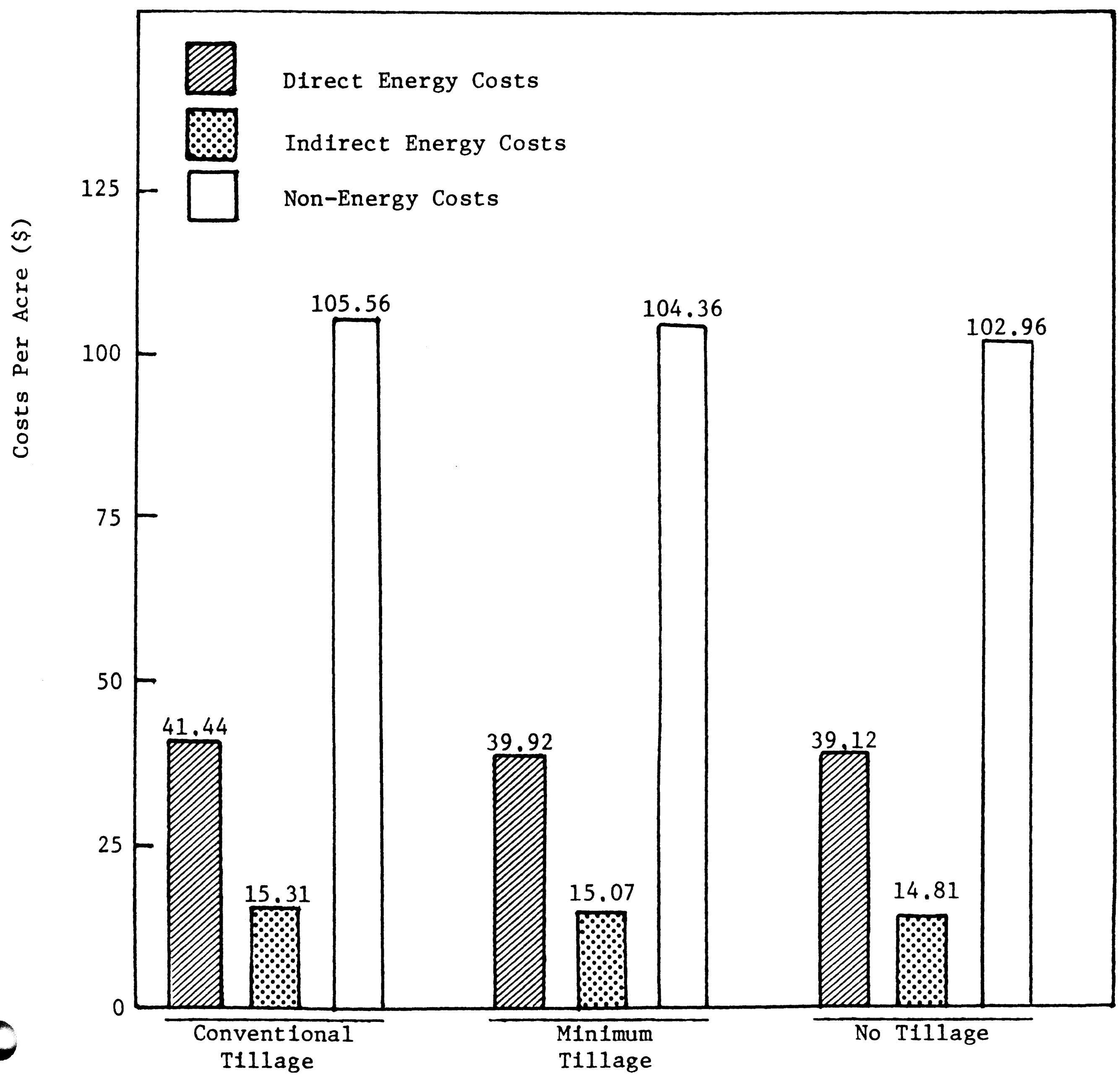
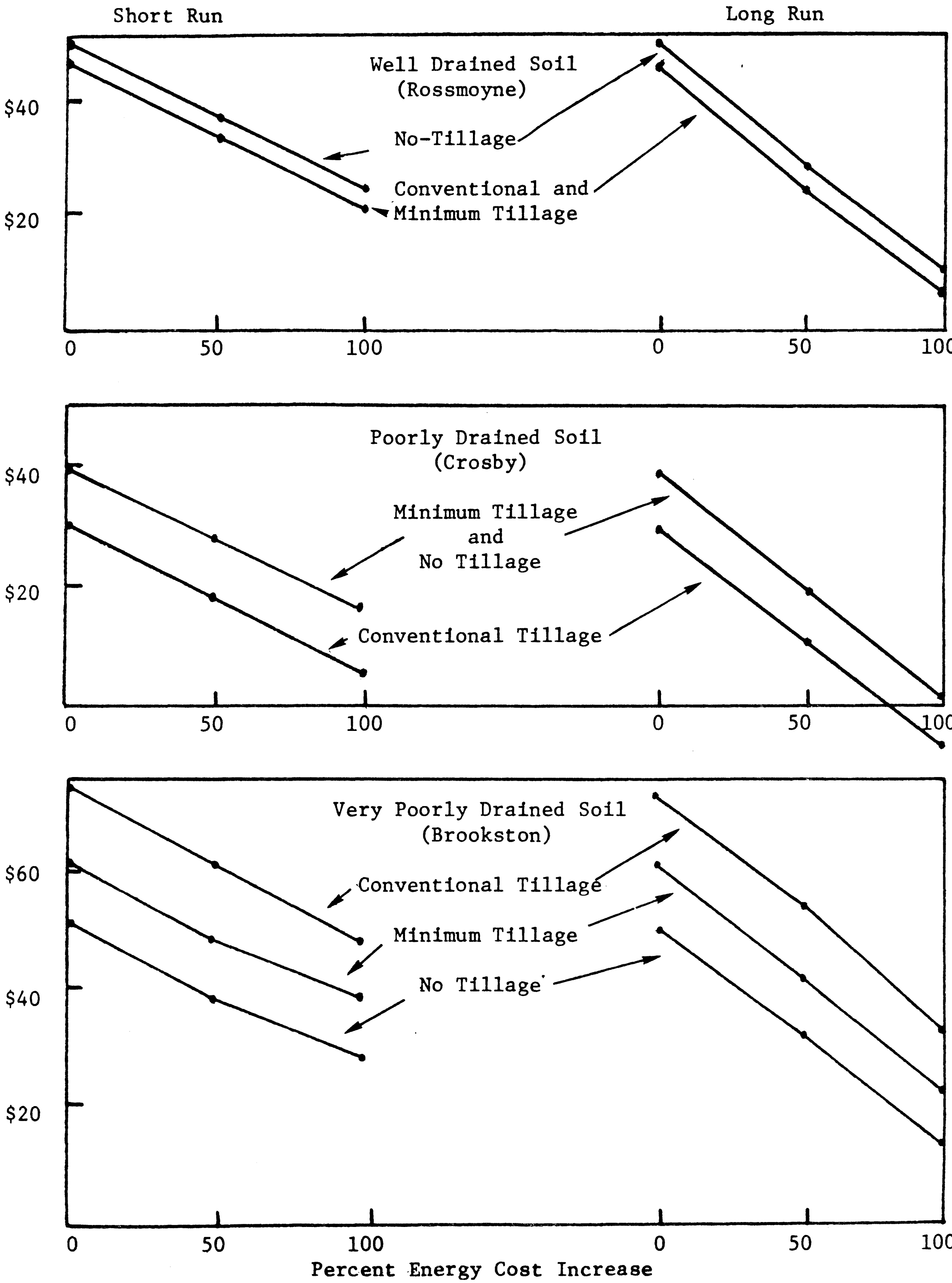


Figure 2. Effects of Short and Long Run Energy Cost Increases on Net Return Per Acre for Simulated Corn-Soybean Farm Situations With Three Tillage Systems and Three Soil Types



behind all of them is to collect the heat from the sun to substitute for some of the expensive fossil fuel sources. Of course, one of the problems of solar drying is that cloudy days necessitate additional heating sources, typically electric heat. Also, a relatively high investment is required for the limited heat which is supplied. However, solar systems do appear to be economically feasible with expected higher energy prices.

In short, it appears that crop rotations will remain about the same under higher energy prices. Nitrogen fertilizer use will be reduced only slightly and tillage systems will shift ever so slightly toward reduced tillage. Solar energy will be used as a supplementary drying and heating source, and other innovations will make our fossil fuel using equipment more efficient.

Energy scarcity also may offer agriculture new opportunities. These opportunities stem from the technical ability of agriculture to produce renewable energy sources. Methane generation from manure, electric power generation from corn stover, and alcohol production from corn grain have been mentioned as new energy sources from agriculture. We can dream of our farmers being the sheiks of the future!

The economic feasibility of methane generation is questionable within the near future. Several studies have concluded that methane generation has a bleak future unless new technical advances are made (Costigane, et al., and Miranowski, et al.).

Corn stover use in electric power generation appears to have some potential. The idea is to use corn stover as a supplementary source of fuel for coal burning generating plants. Studies have indicated that Ohio has at least 45 privately and publically owned boiler facilities which have the capacity to burn refuse or corn stover as a supplementary fuel (Luttner and Hitzhusen). What remains to be seen is how much of the vast quantities of corn stover might be economically harvested, stored, transported, and burned; however, it is likely that some farmers will be selling their stover in the not too distant future.

Alcohol production from crops is technically feasible. It is being done on a wide scale in Brazil where alcohol derived from sugar cane is expected to supply 20 percent of the fuel. Alcohol production from corn also is technically possible and has been widely publicized. With $2.00 per bushel of corn and a doubling of gasoline prices, it appears that alcohol production would be at the breakeven point in terms of economic feasibility. However, large quantities of corn would be needed to supply a fraction of the national needs. It is estimated that a national gasoline-alcohol program (10 percent alcohol - 90 percent gasoline blend) would permit corn prices to rise by nearly 50 percent while shifting another 22 million cropland acres into corn production (Wisner and Gidel). Indeed, a national gasoline-alcohol program would be a windfall to farmers, but it should not be expected until fuel prices more than double.

Finally, increased energy prices will encourage the recycling of wastes. Refeeding of livestock manures seems to be on the threshold of acceptance and promises to lower feed ration costs. Increased energy prices will improve further the economic advantage of refeeding manures. Also, higher energy prices will encourage communities to landspread municipal sewage sludge rather than to use energy intensive incineration. The fertilizer nutrients in sludge can be of benefit to the farmer as long as the sludge is applied in an environmentally safe method.

Conclusions

Higher energy prices seem inevitable. Several changes in U.S. and Ohio agriculture are on the horizon if energy prices double. At the national level, agriculture would be able to compete with other sectors for scarce energy supplies, and total energy use would decline only slightly. However, farmers using irrigated acres would be in dire straits. Increased dryland farming would increase total cropland acreage. More legumes would be produced to supply nitrogen needs and commercial nitrogen usage would decline by about 14 percent. Crop production systems would not shift to labor intensive technologies, but they would make energy conserving adjustments.

Small changes in crop acreages would occur in Ohio. More legumes would be planted, but the continuous corn and corn soybean rotations of western Ohio would remain. Commercial nitrogen use would decline by about 10 percent. No dramatic changes toward reduced tillage systems could be expected to result from higher energy prices. Solar drying would be used widely.

The largest changes would occur in the use of agricultural products and its resources. Corn stover would be a likely fuel for generating plants, corn alcohol might see limited use in gasoline-alcohol blends, refeeding of livestock manures would be highly profitable, and communities would seek agricultural land for sewage sludge landspreading.

References

Carter, H. and J. Youde, "Some Impacts of the Changing Energy Situation on U.S. Agriculture." Journal of Agricultural Economics, 56(1974): 878-888.

Costigane, W. D., et al. "Economics of Digestion of Manure for Methane Production on Small Farms." in Food, Fuel, and Fertilizer, Canadian Plains Research Center, 1974.

Dvoskin, D. and E. O. Heady, U.S. Agricultural Production Under Limited Energy Supplies, High Energy Prices, and Expanding Agricultural Exports, CARD, Iowa State University, 1976.

Forster, D. L. and N. Rask, "Changes in Fertilizer Usage and Crop Production Under Scarce Energy Supplies." in Agriculture and Energy, Academic Press, Inc., 1977.

Luttner, M. and F. Hitzhusen. "Resource Recovery From Solid Waste." ESO-293, Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1975.

Miranowski, J. A. et al., "Economic Feasibility of Methane Generation and Livestock and Crop Waste Recycling for a Typical Iowa Family Farm." in Agriculture and Energy. Academic Press, Inc., 1977.

Rask, N. and D. L. Forster, "Corn Tillage Systems -- Will Energy Costs Determine the Choice?" in Agriculture and Energy. Academic Press, Inc., 1977.

Sitterley, J. H. "Land Use in Ohio, 1900-1970: How and Why It Has Changed." Research Bulletin 1084, Ohio Agricultural Research and Development Center, 1976.

U.S.D.A., Economic Research Service. The U.S. Food and Fiber Sector: Energy Use and Outlook. Report for the Committee on Agriculture and Forestry, U.S. Senate, 1974.